

Amendments to the Claims:

This listing of claims replaces all prior versions and listings of claims in the application:

Listing of Claims:

1 – 22. (Canceled)

23. (Currently amended) A storage device controller, comprising:

snapshot logic;

copy logic; and

an internal cache;

the controller being operable to communicate with a replication manager to receive a snapshot command issued by the replication manager, the snapshot command specifying a range of data bytes of a source volume;

the controller being operable to communicate with the replication manager to receive a copy command specifying the source volume and a target volume;

the controller being operable to receive a write command specifying the source volume;

the snapshot logic being operable, in response to the snapshot command, to take a snapshot of the range, the snapshot including a snapshot map and snapshot data, the snapshot map being stored by the snapshot logic in the internal cache and the snapshot data being stored by the snapshot logic in a snapshot volume; and

the copy logic being operable in response to receiving the copy command to generate and send one or more storage device commands to one or more storage devices for the source and target volumes to copy data from the source volume directly to the target volume without having a file server in the data path, the copy logic using the snapshot map and the snapshot data to maintain coherency of the copied data.

24. (Previously Presented) The storage device controller of claim 23, wherein the storage device controller is a RAID controller.

25. (Previously presented) The storage device controller of claim 23, wherein:

the range of the source volume specified by the snapshot command is a first range, and the write command specifies a second range of data bytes of the source volume; and

the controller is operable, in response to receiving the write command while the source volume is being copied to the target volume, to hold the write command in the cache, check if the first range overlaps with the second range and, if so, copy the second range from the source volume to the snapshot volume, update the snapshot map, and then allow the write command to write to the source volume.

26. (Previously presented) The storage device controller of claim 23, wherein the replication manager is executed on a file server.

27. (Previously presented) The storage device controller of claim 26, wherein the file server is connected to a storage area network switch and the file server communicates with the storage device controller through the storage area network switch.

28. (Previously presented) The storage device controller claim 23, wherein the replication manager is operable to control multiple storage device controllers.

29. (Previously presented) The storage device controller of claim 23, wherein:

the one or more storage device commands include SCSI commands.

30. (Previously presented) The storage device controller of claim 23, wherein:

the controller is operable to send the one or more storage device commands by using one of an in-band protocol or an out-of-band protocol.

31. (Previously presented) A method comprising:

receiving at a storage device controller a snapshot command issued by a replication manager, the snapshot command specifying a range of data bytes of a source volume;

in response to receiving the snapshot command, the storage device controller taking a snapshot of the range specified using device control commands to control one or more devices on which the source is stored, the snapshot including a snapshot map and snapshot data, and storing the snapshot map and the snapshot data in a cache internal to the storage device controller and a snapshot volume, respectively;

receiving at the storage device controller a copy command from the replication manager, the copy command specifying a copy operation from the source volume to a target volume; and

in response to receiving the copy command, the storage device controller generating and sending storage device commands to one or more storage devices of the source and target volumes to copy data directly from the source volume to the target volume, the storage device controller also using the snapshot map and snapshot data to maintain coherency of the copied data.

32. (Previously presented) The method of claim 31, wherein:

the storage device is a RAID controller.

33. (Previously presented) The method of claim 31, wherein the range specified by the snapshot command is a first range, the method further comprising:

receiving at the storage controller device a write command issued from a file system, the write command specifying a second range of data bytes of the source volume, the write copy command being received while the source volume is being copied to the target volume;

in response to receiving the write command, the storage device controller holding the write command in the cache, checking if the first range overlaps with the second range and, if so, copying the second range from the source volume to the snapshot volume, updating the snapshot map, and then allowing the write command to write to the source volume.

34. (Previously presented) The method of claim 31, wherein the replication manager is executed on a file server.

35. (Previously presented) The method of claim 34, wherein the file server is connected to a storage area network switch and the file server communicates with the storage device controller through the storage area network switch.

36. (Previously presented) The method of claim 31, wherein the replication manager is operable to control multiple storage device controllers.

37. (Previously presented) The method of claim 31, wherein the storage device commands include a SCSI command.

38. (Previously presented) The method of claim 31, wherein storage device commands are sent using one of an in-band protocol or an out-of-band protocol.

39. (Previously presented) A computer-implemented method comprising:

using a remote application to manage a source storage device controller and a destination storage device controller, the source storage device controller being operable to control access to a source data object and the destination device controller being operable to control access to a destination data block, the storage device controllers being operable to issue storage device commands;

internally generating within the source storage device controller a snapshot version for each block of the source data object changed by one or more write operations to the block during the course of a copy operation; and

copying each block of the source data object to a corresponding block in the destination data object in the absence of the snapshot version of the block and otherwise copying the snapshot version of the source data object block to the corresponding block in the destination data object, wherein data is directly transferred between the source and destination storage device controllers without traversing a server operable to process file system requests, and wherein coherency of the data transferred between the source and destination storage device controllers is maintained without requiring any file system to maintain a snapshot map.

40. (Previously presented) A system comprising:

a replication manager that is operable to issue a snapshot command; and
a storage device controller that is operable (i) to communicate with the replication manager to receive the snapshot command and (ii) to receive a copy command, the snapshot command specifying a range data bytes of a source volume, the copy command specifying the source volume and a target volume; wherein

the controller is operable to receive a write command specifying the source volume;
the controller is operable, in response to receiving the snapshot command, to take a snapshot of the range, the snapshot including a snapshot map and snapshot data, the snapshot map being stored in a cache internal to the storage device controller and the snapshot data being stored in a snapshot volume; and

the controller is operable, in response to receiving the copy command, to generate and send one or more storage device commands to one or more storage devices for the source and target volumes to copy data from the source volume directly to the target volume without having a file server in the data path, the controller using the snapshot map and the snapshot data to maintain coherency of the copied data.

41. (Previously presented) The system of claim 40, wherein the replication manager is executed on a file server and is operable to control the source storage device controller and one or more other storage device controllers.

42. (Previously presented) The system of claim 40, further comprising a list of source data blocks to be copied that are reordered to increase copy speed.

43. (Previously presented) The system of claim 42, wherein the list of blocks to be copied is buffered while the storage device controller awaits further copy commands.

44. (Previously presented) The system of claim 40, wherein the replication manager is operable to inserted control data before and after a source data block being copied.

45. (Previously presented) The system of claim 40, wherein the replication manager is operable to specify a block size so that the storage device controller writes fixed-size blocks.